MLpart

June 22, 2017

In [117]:
```
%matplotlib inline
import pandas as pd
import matplotlib.pyplot as plt
import matplotlib.pyplot as plt

import seaborn
seaborn.set(style='ticks')

from IPython.display import Audio

import numpy as np
import scipy

import mir_eval
import librosa

d = pd.read_csv("/Users/reyno392/Desktop/Programming/bigdataproject/output-final.csv")
d.describe()
```

Out[117]:
```
             mfcss0        mfcss1        mfcss2        mfcss3        mfcss4  \
count  15878.000000  15878.000000  15878.000000  15878.000000  15878.000000
mean    -423.909381    159.290538    -24.893228     15.019428     33.746356
std       94.639789     29.435250     21.778312     11.841057     11.764870
min     -931.677719     39.898847   -106.694800    -33.921526    -29.246400
25%     -476.017744    141.989375    -39.712573      7.045423     26.768538
50%     -415.611308    161.921309    -23.979239     15.028690     34.455215
75%     -361.143435    179.695510     -9.860378     23.253927     41.616460
max      -92.378454    258.706208     63.630408     64.957047     76.831597

             mfcss5        mfcss6        mfcss7        mfcss8        mfcss9  \
count  15878.000000  15878.000000  15878.000000  15878.000000  15878.000000
mean     -15.152955      1.543789     10.578178    -11.355057      2.482382
std       10.258179     11.253760      8.561556      7.394772      8.888972
min      -60.941695    -43.376065    -32.931751    -47.183815    -29.021087
25%      -22.097443     -6.016731      5.768405    -16.221324     -3.295486
50%      -15.092507      1.132838     11.312888    -11.326262      1.848496
75%       -8.246649     10.071626     16.437185     -6.405290      9.174909
```

```
max       22.143577     32.995945     40.878149     13.489550     32.437802

                ...         contrast3     contrast4     contrast5     contrast6  \
count           ...      15878.000000  15878.000000  15878.000000  15878.000000
mean            ...         15.594197     17.163963     61.852865     14.330051
std             ...          1.400902      1.495602      4.411277      1.967879
min             ...         11.467180     12.467453     20.932720      4.766859
25%             ...         14.667270     16.149527     59.075275     13.317150
50%             ...         15.400136     16.944605     62.039100     14.213044
75%             ...         16.250967     17.948888     64.839505     15.451015
max             ...         27.526058     29.728328     74.808438     34.170896

           tonnetz0      tonnetz1      tonnetz2      tonnetz3      tonnetz4  \
count  15878.000000  15878.000000  15878.000000  15878.000000  15878.000000
mean      -0.007840      0.009440      0.019431      0.003478      0.000854
std        0.013069      0.018001      0.067605      0.067527      0.014739
min       -0.081372     -0.055369     -0.288997     -0.378189     -0.080152
25%       -0.013722     -0.001541     -0.017952     -0.025159     -0.004840
50%       -0.005926      0.008093      0.006747      0.004878      0.001855
75%       -0.000085      0.019736      0.042374      0.032940      0.007944
max        0.048793      0.157006      0.395262      0.394929      0.084532

           tonnetz5
count  15878.000000
mean      -0.003816
std        0.019407
min       -0.100362
25%       -0.011295
50%       -0.000704
75%        0.006958
max        0.083421

[8 rows x 193 columns]
```

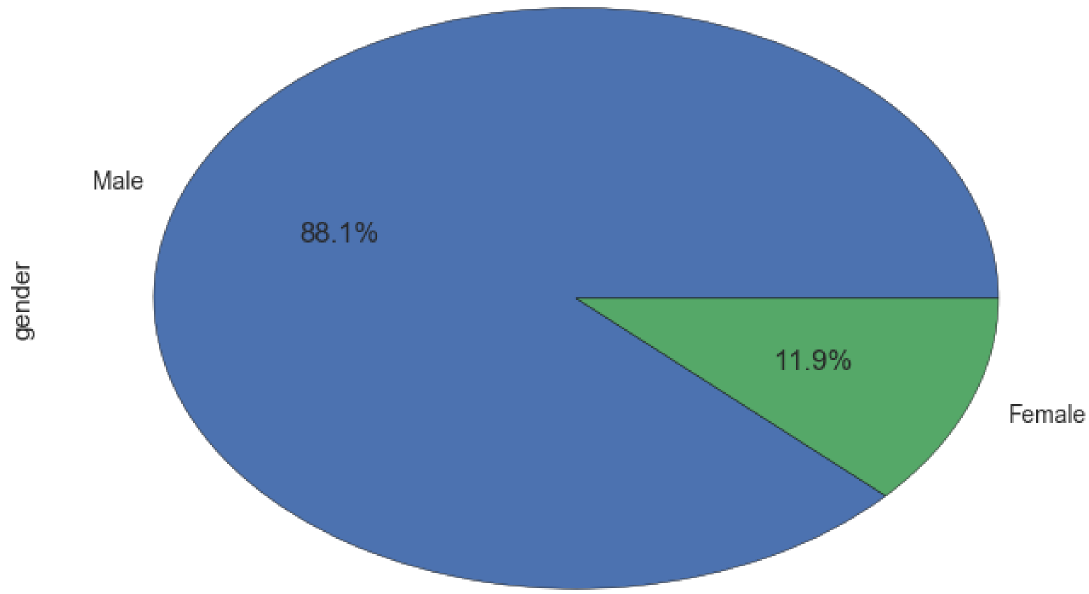
In [103]:
```
d.isnull().values.any()
```

Out[103]: False

In [ ]:

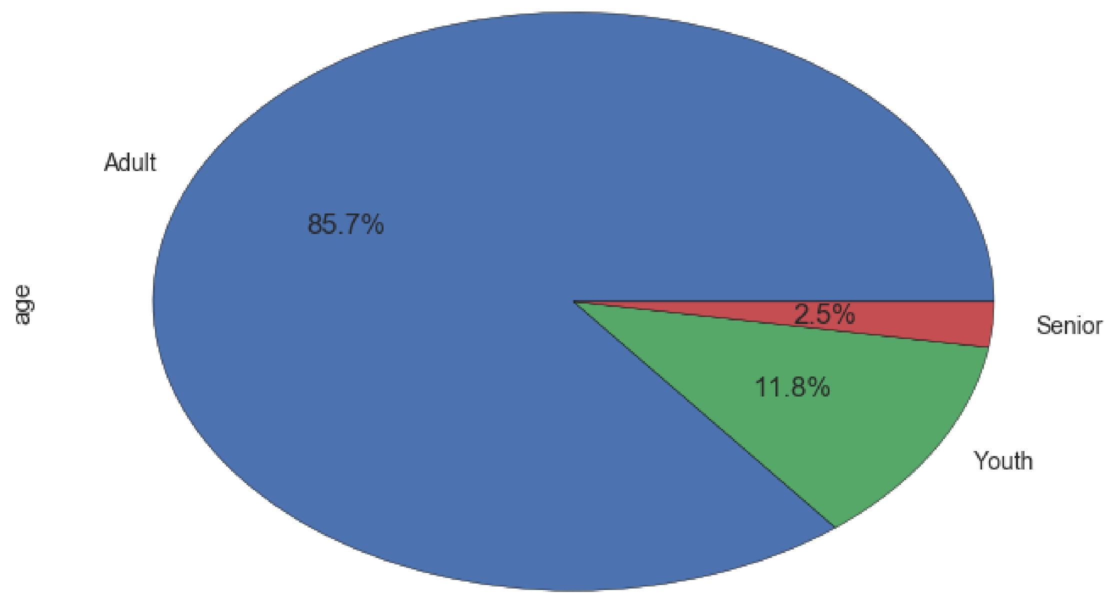
In [104]:
```
d.gender.value_counts().plot(kind='pie', autopct='%1.1f%%')
```

Out[104]: <matplotlib.axes._subplots.AxesSubplot at 0x10c7af5c0>



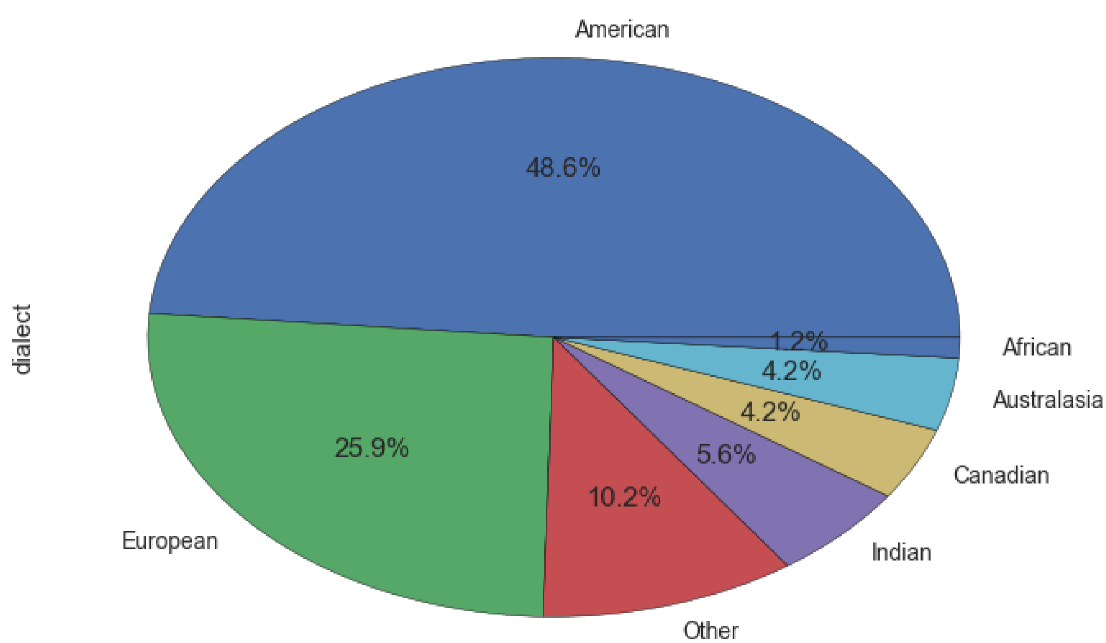

```
In [105]: d.age.value_counts().plot(kind="pie", autopct='%1.1f%%')

Out[105]: <matplotlib.axes._subplots.AxesSubplot at 0x10c7a5278>
```




```
In [106]: d.dialect.value_counts().plot(kind="pie", autopct='%1.1f%%')

Out[106]: <matplotlib.axes._subplots.AxesSubplot at 0x10c7bd4e0>
```



In [107]:
```
from sklearn.model_selection import train_test_split
from sklearn import tree
from sklearn.metrics import accuracy_score
from sklearn.model_selection import cross_val_score
```

In [108]:
```
d.keys()
```

Out[108]:
```
Index(['Directory', 'mfcss0', 'mfcss1', 'mfcss2', 'mfcss3', 'mfcss4', 'mfcss5',
       'mfcss6', 'mfcss7', 'mfcss8',
       ...
       'contrast6', 'tonnetz0', 'tonnetz1', 'tonnetz2', 'tonnetz3', 'tonnetz4',
       'tonnetz5', 'gender', 'age', 'dialect'],
      dtype='object', length=197)
```

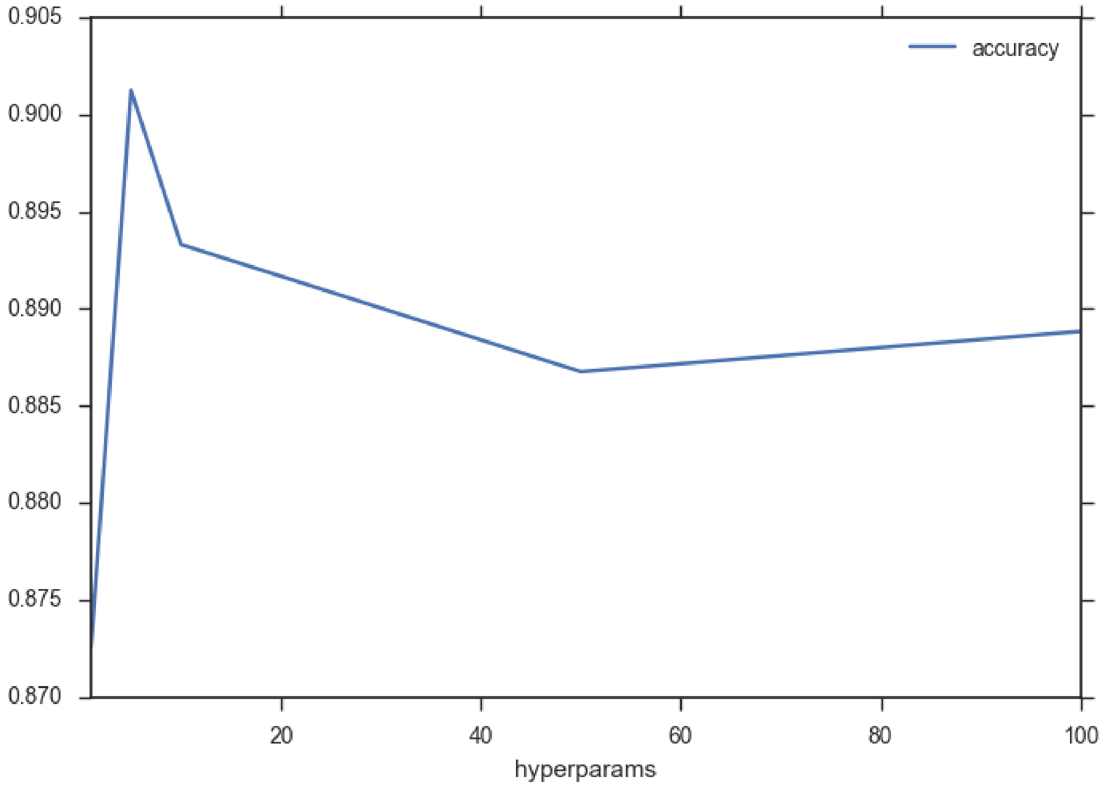
In [109]:
```
del d["Directory"]
Y_gender = d["gender"]
Y_age = d["age"]
Y_dialect = d["dialect"]
del d["gender"]
del d["age"]
del d["dialect"]
X = d
```

In [110]:
```
hyperparams = [1, 5, 10, 50, 100]
accuracy = []

for params in hyperparams:
    clf = tree.DecisionTreeClassifier(max_depth=params)
    scores = cross_val_score(clf, X, Y_gender, cv=5)
    accuracy.append(scores.mean())

d = pd.DataFrame({"hyperparams": hyperparams, "accuracy": accuracy})
d.plot(x="hyperparams", y="accuracy")
```

Out[110]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x10c8616d8>
```

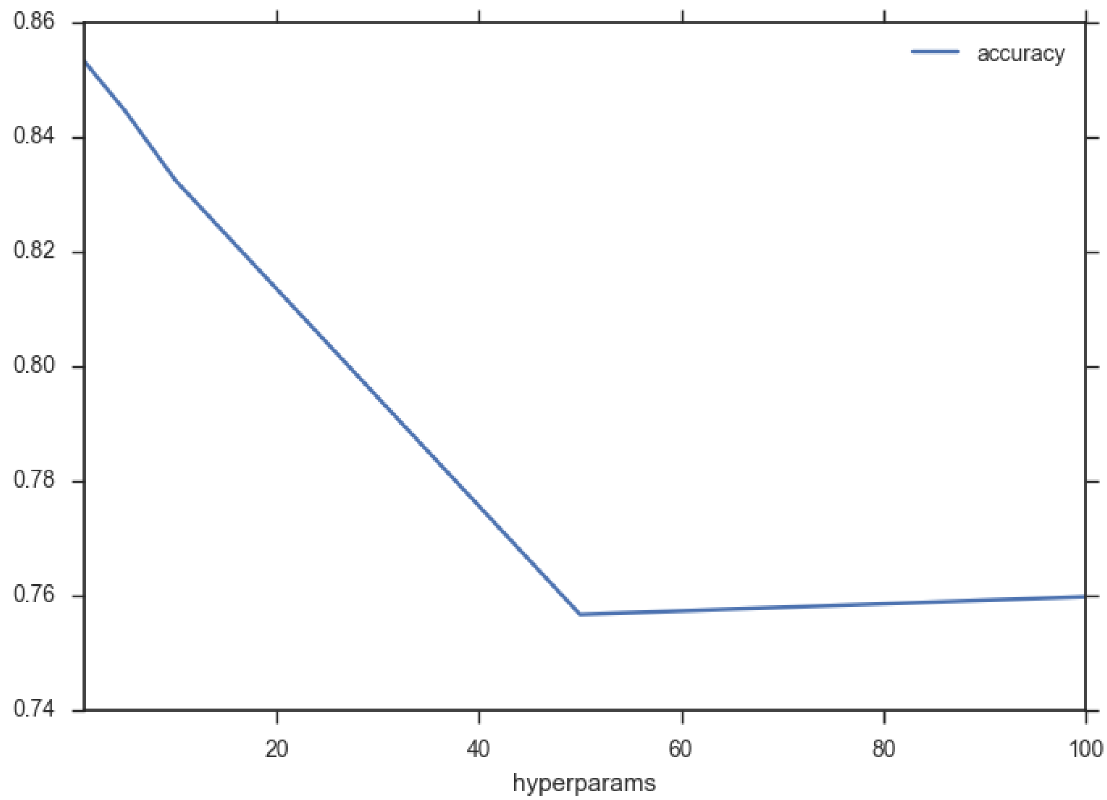



```
In [112]: hyperparams = [1, 5, 10, 50, 100]
          accuracy = []

          for params in hyperparams:
              clf = tree.DecisionTreeClassifier(max_depth=params)
              scores = cross_val_score(clf, X, Y_age, cv=5)
              accuracy.append(scores.mean())

          d = pd.DataFrame({"hyperparams": hyperparams, "accuracy": accuracy})
          d.plot(x="hyperparams", y="accuracy")

Out[112]: <matplotlib.axes._subplots.AxesSubplot at 0x1128034a8>
```

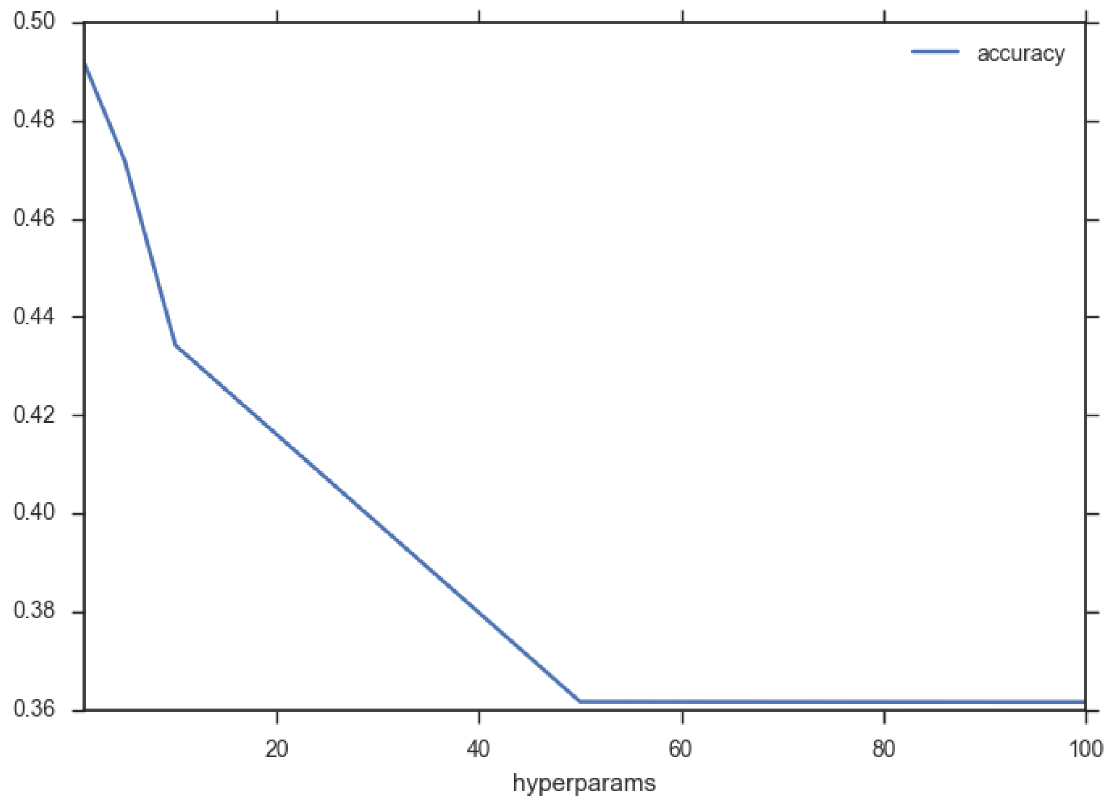



```
In [111]: hyperparams = [1, 5, 10, 50, 100]
          accuracy = []

          for params in hyperparams:
              clf = tree.DecisionTreeClassifier(max_depth=params)
              scores = cross_val_score(clf, X, Y_dialect, cv=5)
              accuracy.append(scores.mean())

          d = pd.DataFrame({"hyperparams": hyperparams, "accuracy": accuracy})
          d.plot(x="hyperparams", y="accuracy")

Out[111]: <matplotlib.axes._subplots.AxesSubplot at 0x112a70710>
```



In [127]:
```
y, sr = librosa.load("/Users/reyno392/Desktop/Programming/bigdataproject/data/allison-
spectrogram = np.abs(librosa.stft(y))
melspec = librosa.feature.melspectrogram(y=y, sr=sr)
stft = np.abs(librosa.stft(y))
mfccs = np.mean(librosa.feature.mfcc(y=y, sr=sr, n_mfcc=40).T, axis=0)
mel = np.mean(librosa.feature.melspectrogram(y, sr=sr).T, axis=0)
contrast = np.mean(librosa.feature.spectral_contrast(S=stft, sr=sr).T, axis=0)
tonnetz = np.mean(librosa.feature.tonnetz(y=librosa.effects.harmonic(y), sr=sr).T, axi
chroma = np.mean(librosa.feature.chroma_stft(S=stft, sr=sr).T,axis=0)
features = np.hstack([mfccs,chroma,mel,contrast,tonnetz])
features = features.reshape(1, -1)
```

In [128]:
```
clf = tree.DecisionTreeClassifier(max_depth=5)
clf.fit(X, Y_gender)
pred = clf.predict(features)
pred
```

Out[128]:
```
array(['Male'], dtype=object)
```

In [129]:
```
clf = tree.DecisionTreeClassifier(max_depth=5)
clf.fit(X, Y_age)
pred = clf.predict(features)
pred
```

```
Out[129]: array(['Adult'], dtype=object)
```

```
In [130]: clf = tree.DecisionTreeClassifier(max_depth=1)
          clf.fit(X, Y_dialect)
          pred = clf.predict(features)
          pred
```

```
Out[130]: array(['American'], dtype=object)
```

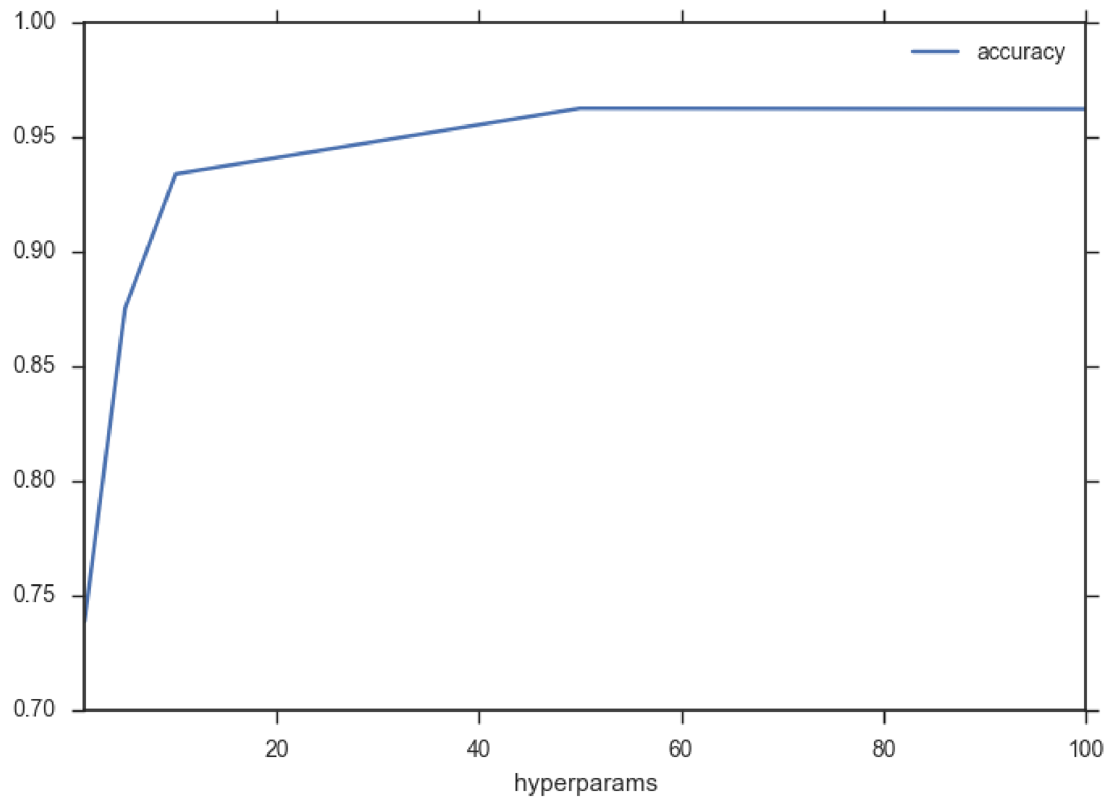
```
In [149]: from imblearn.over_sampling import RandomOverSampler
          ros = RandomOverSampler()
          X_resampled, y_resampled = ros.fit_sample(X, Y_gender)
          x_re_gender = pd.DataFrame(data=X_resampled, columns=X.columns)
          y_re_gender = pd.DataFrame({"gender": y_resampled})

          hyperparams = [1, 5, 10, 50, 100]
          accuracy = []

          for params in hyperparams:
              clf = tree.DecisionTreeClassifier(max_depth=params)
              scores = cross_val_score(clf, x_re_gender, y_re_gender['gender'], cv=5)
              accuracy.append(scores.mean())

          d = pd.DataFrame({"hyperparams": hyperparams, "accuracy": accuracy})
          d.plot(x="hyperparams", y="accuracy")
```

```
Out[149]: <matplotlib.axes._subplots.AxesSubplot at 0x113c56c50>
```



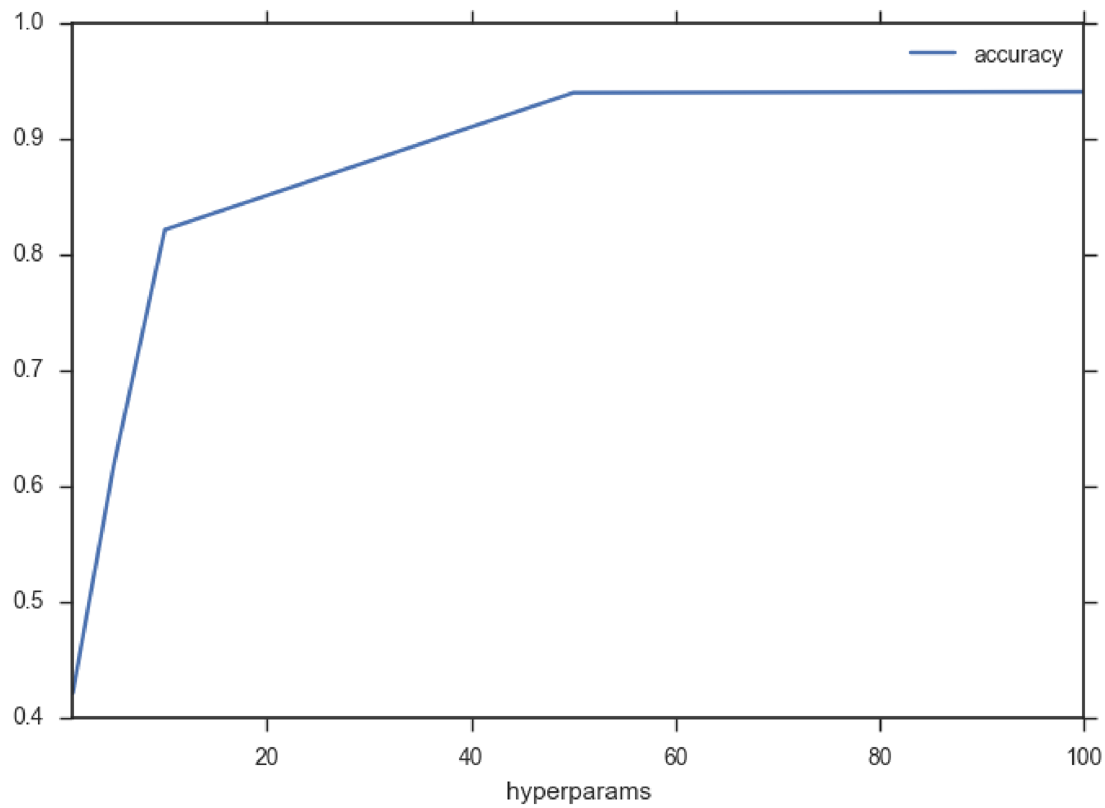

```
In [151]: ros = RandomOverSampler()
          X_resampled, y_resampled = ros.fit_sample(X, Y_age)
          x_re_age = pd.DataFrame(data=X_resampled, columns=X.columns)
          y_re_age = pd.DataFrame({"age": y_resampled})

          hyperparams = [1, 5, 10, 50, 100]
          accuracy = []

          for params in hyperparams:
              clf = tree.DecisionTreeClassifier(max_depth=params)
              scores = cross_val_score(clf, x_re_age, y_re_age['age'], cv=5)
              accuracy.append(scores.mean())

          d = pd.DataFrame({"hyperparams": hyperparams, "accuracy": accuracy})
          d.plot(x="hyperparams", y="accuracy")

Out[151]: <matplotlib.axes._subplots.AxesSubplot at 0x11642d588>
```



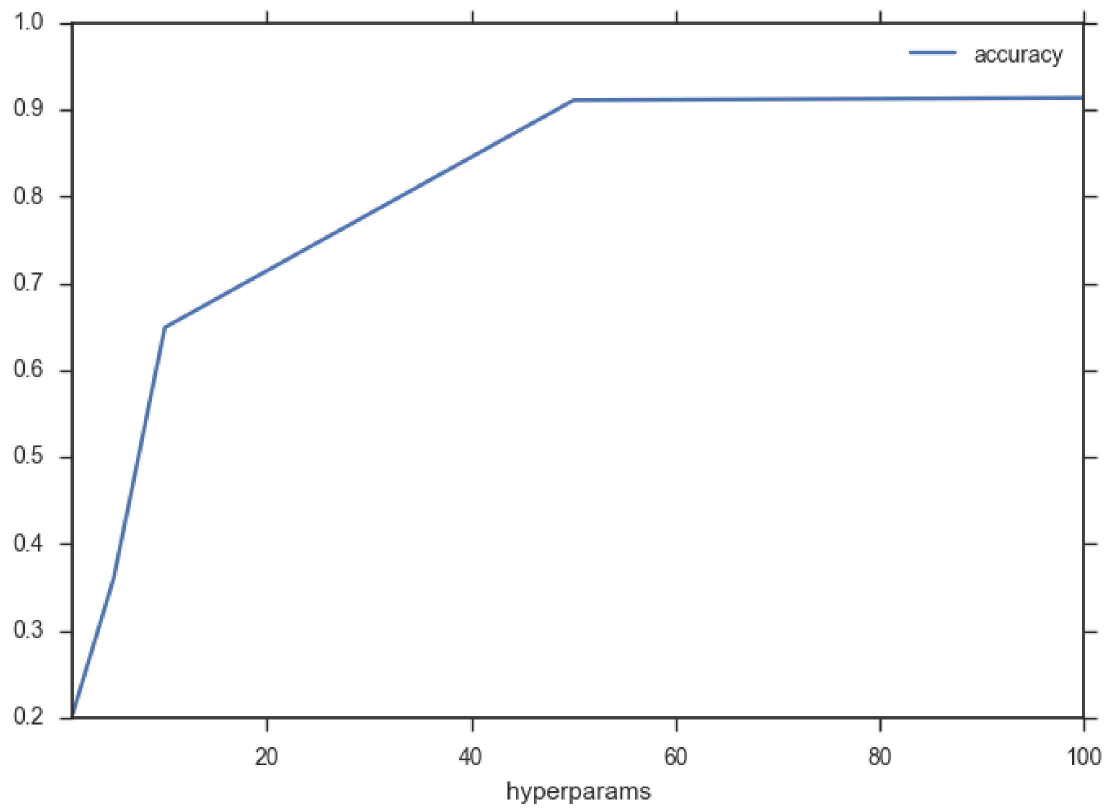

```
In [152]: ros = RandomOverSampler()
          X_resampled, y_resampled = ros.fit_sample(X, Y_dialect)
          x_re_dialect = pd.DataFrame(data=X_resampled, columns=X.columns)
          y_re_dialect = pd.DataFrame({"dialect": y_resampled})

          hyperparams = [1, 5, 10, 50, 100]
          accuracy = []

          for params in hyperparams:
              clf = tree.DecisionTreeClassifier(max_depth=params)
              scores = cross_val_score(clf, x_re_dialect, y_re_dialect['dialect'], cv=5)
              accuracy.append(scores.mean())

          d = pd.DataFrame({"hyperparams": hyperparams, "accuracy": accuracy})
          d.plot(x="hyperparams", y="accuracy")

Out[152]: <matplotlib.axes._subplots.AxesSubplot at 0x1142fc1d0>
```



In [ ]:

In [186]:
```
clf_gender = tree.DecisionTreeClassifier(max_depth=50)
clf_gender.fit(x_re_gender, y_re_gender['gender'])

clf_gender1 = tree.DecisionTreeClassifier(max_depth=40)
clf_gender1.fit(x_re_gender, y_re_gender['gender'])

clf_gender2 = tree.DecisionTreeClassifier(max_depth=30)
clf_gender2.fit(x_re_gender, y_re_gender['gender'])

clf_gender3 = tree.DecisionTreeClassifier(max_depth=20)
clf_gender3.fit(x_re_gender, y_re_gender['gender'])

clf_gender4 = tree.DecisionTreeClassifier(max_depth=10)
clf_gender4.fit(x_re_gender, y_re_gender['gender'])


clf_age = tree.DecisionTreeClassifier(max_depth=50)
clf_age.fit(x_re_age, y_re_age['age'])
```

```
clf_age1 = tree.DecisionTreeClassifier(max_depth=40)
clf_age1.fit(x_re_age, y_re_age['age'])

clf_age2 = tree.DecisionTreeClassifier(max_depth=30)
clf_age2.fit(x_re_age, y_re_age['age'])

clf_age3 = tree.DecisionTreeClassifier(max_depth=20)
clf_age3.fit(x_re_age, y_re_age['age'])

clf_age4 = tree.DecisionTreeClassifier(max_depth=10)
clf_age4.fit(x_re_age, y_re_age['age'])


clf_dialect = tree.DecisionTreeClassifier(max_depth=50)
clf_dialect.fit(x_re_dialect, y_re_dialect['dialect'])

clf_dialect1 = tree.DecisionTreeClassifier(max_depth=40)
clf_dialect1.fit(x_re_dialect, y_re_dialect['dialect'])

clf_dialect2 = tree.DecisionTreeClassifier(max_depth=30)
clf_dialect2.fit(x_re_dialect, y_re_dialect['dialect'])

clf_dialect3 = tree.DecisionTreeClassifier(max_depth=20)
clf_dialect3.fit(x_re_dialect, y_re_dialect['dialect'])

clf_dialect4 = tree.DecisionTreeClassifier(max_depth=10)
clf_dialect4.fit(x_re_dialect, y_re_dialect['dialect'])
```

```
Out[186]: DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=10,
                      max_features=None, max_leaf_nodes=None,
                      min_impurity_split=1e-07, min_samples_leaf=1,
                      min_samples_split=2, min_weight_fraction_leaf=0.0,
                      presort=False, random_state=None, splitter='best')
```

```
In [221]: y, sr = librosa.load("/Users/reyno392/Desktop/Programming/bigdataproject/me.wav", sr=2
          spectrogram = np.abs(librosa.stft(y))
          melspec = librosa.feature.melspectrogram(y=y, sr=sr)
          stft = np.abs(librosa.stft(y))
          mfccs = np.mean(librosa.feature.mfcc(y=y, sr=sr, n_mfcc=40).T, axis=0)
          mel = np.mean(librosa.feature.melspectrogram(y, sr=sr).T, axis=0)
          contrast = np.mean(librosa.feature.spectral_contrast(S=stft, sr=sr).T, axis=0)
          tonnetz = np.mean(librosa.feature.tonnetz(y=librosa.effects.harmonic(y), sr=sr).T, axi
          chroma = np.mean(librosa.feature.chroma_stft(S=stft, sr=sr).T,axis=0)
          features = np.hstack([mfccs,chroma,mel,contrast,tonnetz])
          features = features.reshape(1, -1)
          pred = clf_gender2.predict(features)
          print(pred)
          pred = clf_age2.predict(features)
```

```
print(pred)
pred = clf_dialect2.predict(features)
print(pred)
```

```
['Male']
['Adult']
['American']
```

```
In [198]: y_pred_gender = clf_gender1.predict(X)
          y_pred_age = clf_age1.predict(X)
          y_pred_dialect = clf_dialect1.predict(X)

In [199]: from sklearn.metrics import f1_score, precision_score, recall_score, classification_re

          print("gender accuracy score: " + str(accuracy_score(Y_gender, y_pred_gender)))
          print("gender f1_score: " + str(f1_score(Y_gender, y_pred_gender, average="macro")))
          print("gender precision: " + str(precision_score(Y_gender, y_pred_gender, average="mac
          print("gender recall: " + str(recall_score(Y_gender, y_pred_gender, average="macro"))

          print("age accuracy score: " + str(accuracy_score(Y_age, y_pred_age)))
          print("age f1_score: " + str(f1_score(Y_age, y_pred_age, average="macro")))
          print("age precision: " + str(precision_score(Y_age, y_pred_age, average="macro")))
          print("age recall: " + str(recall_score(Y_age, y_pred_age, average="macro")) + "\n")

          print("dialect accuracy score: " + str(accuracy_score(Y_dialect, y_pred_dialect)))
          print("dialect f1_score: " + str(f1_score(Y_dialect, y_pred_dialect, average="macro"))
          print("dialect precision: " + str(precision_score(Y_dialect, y_pred_dialect, average="
          print("dialect recall: " + str(recall_score(Y_dialect, y_pred_dialect, average="macro"
```

```
gender accuracy score: 0.999937019776
gender f1_score: 0.999849886751
gender precision: 0.999735589635
gender recall: 0.999964255076

age accuracy score: 0.996913969014
age f1_score: 0.980250719912
age precision: 0.963784183296
age recall: 0.998799813849

dialect accuracy score: 1.0
dialect f1_score: 1.0
dialect precision: 1.0
dialect recall: 1.0
```

```
In [203]: print(clf_gender.score(X, Y_gender))
          print(clf_gender1.score(X, Y_gender))
```

```
print(clf_gender2.score(X, Y_gender))
print(clf_gender3.score(X, Y_gender))
print(clf_gender4.score(X, Y_gender))
print()

print(clf_age.score(X, Y_age))
print(clf_age1.score(X, Y_age))
print(clf_age2.score(X, Y_age))
print(clf_age3.score(X, Y_age))
print(clf_age4.score(X, Y_age))
print()

print(clf_dialect.score(X, Y_dialect))
print(clf_dialect1.score(X, Y_dialect))
print(clf_dialect2.score(X, Y_dialect))
print(clf_dialect3.score(X, Y_dialect))
print(clf_dialect4.score(X, Y_dialect))
```

```
1.0
0.999937019776
0.999244237309
0.99565436453
0.972666582693

0.999937019776
0.996913969014
0.994268799597
0.96888776924
0.763131376748

1.0
1.0
0.997228870135
0.952890792291
0.513477767981
```

In [159]:
```
clf_age.score(X, Y_age)
```

Out[159]: 0.99905529663685599

In [160]:
```
clf_dialect.score(X, Y_dialect)
```

Out[160]: 1.0

In [205]:
```
tree.export_graphviz(clf_gender4, out_file='Desktop/Programming/bigdataproject/tree-ge
tree.export_graphviz(clf_age3, out_file='Desktop/Programming/bigdataproject/tree-age.d
tree.export_graphviz(clf_dialect3, out_file='Desktop/Programming/bigdataproject/tree-d
```

```
In [217]: from sklearn.externals import joblib
          joblib.dump(clf_gender4, 'Desktop/Programming/bigdataproject/cfl_gender.pkl')
          joblib.dump(clf_age3, 'Desktop/Programming/bigdataproject/cfl_age.pkl')
          joblib.dump(clf_dialect, 'Desktop/Programming/bigdataproject/cfl_dialect.pkl')

Out[217]: ['Desktop/Programming/bigdataproject/cfl_dialect.pkl']

In [234]: from sklearn import neighbors

          clf_kneighbors_gender = neighbors.KNeighborsClassifier(n_neighbors=2)
          clf_kneighbors_gender.fit(x_re_gender, y_re_gender['gender'])

          clf_kneighbors_age = neighbors.KNeighborsClassifier(n_neighbors=3)
          clf_kneighbors_age.fit(x_re_age, y_re_age['age'])

          clf_kneighbors_dialect = neighbors.KNeighborsClassifier(n_neighbors=7)
          clf_kneighbors_dialect.fit(x_re_dialect, y_re_dialect['dialect'])

Out[234]: KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='minkowski',
                     metric_params=None, n_jobs=1, n_neighbors=7, p=2,
                     weights='uniform')

In [235]: print(clf_kneighbors_gender.score(X, Y_gender))
          print(clf_kneighbors_age.score(X, Y_age))
          print(clf_kneighbors_dialect.score(X, Y_dialect))

0.993387076458
0.9820506361
0.895137926691


In [238]: y, sr = librosa.load("/Users/reyno392/Desktop/Programming/bigdataproject/derp.wav", sr
          spectrogram = np.abs(librosa.stft(y))
          melspec = librosa.feature.melspectrogram(y=y, sr=sr)
          stft = np.abs(librosa.stft(y))
          mfccs = np.mean(librosa.feature.mfcc(y=y, sr=sr, n_mfcc=40).T, axis=0)
          mel = np.mean(librosa.feature.melspectrogram(y, sr=sr).T, axis=0)
          contrast = np.mean(librosa.feature.spectral_contrast(S=stft, sr=sr).T, axis=0)
          tonnetz = np.mean(librosa.feature.tonnetz(y=librosa.effects.harmonic(y), sr=sr).T, axi
          chroma = np.mean(librosa.feature.chroma_stft(S=stft, sr=sr).T,axis=0)
          features = np.hstack([mfccs,chroma,mel,contrast,tonnetz])
          features = features.reshape(1, -1)
          pred = clf_kneighbors_gender.predict(features)
          print(pred)
          pred = clf_kneighbors_age.predict(features)
          print(pred)
          pred = clf_kneighbors_dialect.predict(features)
          print(pred)
```

```
['Male']
['Adult']
['Canadian']
```

```
In [ ]:
```

```
In [ ]:
```

```
In [ ]:
```

```
In [ ]:
```

```
In [ ]:
```